# FRAMEWORK FOR
# TECHNICAL VEGETATION STANDARDS

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## TABLE OF CONTENTS

# PURPOSE AND NEED FOR TECHNICAL VEGETATION STANDARDS

The Montana Strip and Underground Mine Reclamation Act (MSUMRA) specifies the requirements for application, permit issuance, operation, and reclamation for coal mining within the state. Before a permit for mining is issued, the operator must file a bond with the department that will cover the costs of reclamation should the operator fail to complete such work.

Four levels of bond release occur as progressive stages of reclamation are completed. Phase III bond release occurs after at least ten years during which only normal husbandry practices have been employed. This period occurs after all soil lay down, seeding, planting, fertilizing, or other significant reclamation inputs have been completed. The vegetation is now given a chance to become fully established. Eligibility for Phase III bond release is contingent upon meeting the revegetation criteria specified in the Act and the Administrative Rules. This framework provides guidelines for vegetation performance standards for Phase III bond release.

## 1.1 STANDARDS REQUIRED FOR PHASE III BOND RELEASE

MSUMRA and the federal Surface and Mining Control and Reclamation Act (SMCRA) clearly intend that land be reclaimed to a state that fully supports the post-mining land uses that are approved in the mining permit. Such post-mining land uses are predicated on the uses that existed prior to mining, unless an alternative post-mining land use is proposed and approved. Loosely speaking, the intent is that the land be functionally equivalent to its pre-mining state. However, the law clearly recognizes that "duplication of pre-mining topography, soils, and vegetation composition is not practicable" (MCA 82-4-201(3)(d)).

Two different approaches are allowed by law to determine if revegetation criteria have been met, and the reestablished vegetation is "good enough." The first approach specifies the use of a reference area as a control (in the experimental context) for determining quantitative and qualitative parameters and descriptors for the expected vegetation. In this case, the reestablished vegetation is considered adequate when it matches the reference area. Such

reference areas have historically been unmined areas within the permit boundary. They must be under management control of the operator and representative of the "geology, soil, slope and vegetation in the permit area" (MCA 82-4-203(44)). Typically they would be matched to a particular reclaimed area according to specific environmental variables such as slope, aspect, soil type, etc.

The second approach specifies the use of technical standards. Rather than comparing measures of the reclaimed vegetation against similar measures on a specific plot of ground, monitoring results are compared against numeric or descriptive performance standards. Such standards may be derived from historical data, from previously revegetated areas that are compared to historical data, or from data and information provided by U.S. Department of Agriculture or U.S. Department of Interior that may be relevant to the geographic area and the post-mining land use (ARM 17.24.724(3)).

## 1.2 REFERENCE AREAS VS. TECHNICAL STANDARDS

### *1.2.1 Theoretical Basis for Reference Areas*

The basic concept behind using a reference area for setting vegetation success standards is appealing from perspectives of both ecological theory and practicality. In the context of ecological theory, the approach is firmly rooted in a deterministic concept of plant succession towards a climax community: given comparable environmental factors and similar management and disturbance (or lack thereof), over time two plant communities will become indistinguishable (Clements 1936, Borman and Pyke 1994). As long as disturbance and other impacts are held constant, the primary (or even solely) determining factor in plant community composition and productivity is assumed to be the environment. Theoretically, any difference in vegetation between the reference area and the reclaimed area must be due to a difference in environment between the two areas, or specifically, that the reclamation inputs (e.g. soil lay-down, slope, etc.) were inadequate to recreate the same environment.

From a practical standpoint, reference areas would seem to provide a tracking mechanism for climate variations. Unusual drought, cold or other

yearly weather factors are assumed to have equal impact on both the reference and reclaimed areas, and their respective vegetation would be assumed to respond to such factors in a similar manner. Thus the success standard should change with yearly weather variables and will serve as a more appropriate performance measure for the reclaimed vegetation.

Several problems exist with these theories. They include: drawbacks to deterministic theories of vegetation, initial floristic composition, temporal and spatial variability, stage of succession, and environmental comparability. Discussion of these issues follows.

### *1.2.2 Conceptual and Practical Weaknesses of Reference Areas*

Alternative theories of plant succession have existed for some time, being generally more prevalent in the eastern half of the U.S. (Gleason 1926, Whittaker 1951). In the past three decades recognition of the importance of perturbations as organizing or defining elements in plant communities has grown (Westoby 1989, White 1979). Perturbations may be mild and fairly constant or include relatively rare, but cataclysmic events.

Frequent, relatively benign events include impacts such as grazing and trampling by animals, background level insect infestation, etc. Such disturbances may serve to order the plant community, prolonging a relatively steady state of fluctuation about a mean. Less frequent, more extensive or cataclysmic impacts such as fire, flooding, mass wasting, severe drought, epidemic insect infestations, etc. often result in a transition to a different state in which the plant community persists, fluctuating around a different mean than that of the previous state. Recognition has also grown that the *absence* of background perturbations, such as grazing or animal trampling, in communities that previously contained such characteristics can also result in a state change (Savory 1998).

Examples of the former include unnaturally severe fires that sterilize the soil and create hydrophobicity, resulting in the persistence of herbaceous vegetation over many decades in previously forested areas (e.g. 1984 Hawk Creek Fire in the Bull Mountains, MT). Examples of the latter include the

removal of predators, resulting in an increase in prey populations combined with behavioral changes, which further results in the destruction of riparian woody vegetation and the unraveling of previously stable streambanks (e.g. Lamar Valley in Yellowstone National Park).

The recognition that discrete incidents of disturbance and the removal of background disturbance can result in a long term change in vegetation has lead ecologists to develop "state and transition" theories (Bestelmeyer et al. 2003, 2004; Stringham et al. 2001), recognizing that environment alone is not the organizing principle of vegetation, and that multiple steady states within a given environment are possible.

In similar fashion, the impacts of initial floristic composition can have enormous influence on a plant community. For instance, if a fire burns through grassland dominated by cheatgrass, the post-fire community is predictably dominated by cheatgrass, as the seed is numerous and little else exists to compete. A fire in a perennial grass community will be dominated by perennial grasses, even with cheatgrass present, unless the fire burns hot enough to kill perennial root crowns. A similar situation is found in reclamation when salvaged topsoil contains viable seed and is hauled directly to the reclamation site, after which the vegetation is influenced (or even dominated) by plants established from such residual seed.

Temporal and spatial variability is especially pronounced in the complex topography and semi-arid environments common in eastern Montana. Total herbaceous production is greatly affected by annual and seasonal precipitation, seasonal temperature variation, and the timing of precipitation relative to temperature. The relative abundance of species in a plant community also varies greatly from year to year, and some species of herbaceous perennials may be absent in any given year due to climate fluctuations such as prolonged drought, unusual cold, or extreme heat. Spatial variations may occur as a result of factors such as extremely localized precipitation events, differences in insolation and complex interactions with microtopography, and the inherent substrate variability of steep and/or rugged terrain.

By definition, reference areas are presumed to represent mature stages of vegetation and soil development. A purely herbaceous community might possibly reach full development in as little as ten years, assuming that good management and favorable, steady weather patterns have prevailed. In the northern Great Plains this seldom occurs.

To provide a reasonable measure of revegetation success, reference areas must include enough variation in slope, slope position, aspect and edaphic conditions to adequately represent the undisturbed condition of the physiognomic types and their included shrublands.

Random samples drawn from a small reference area comprising only a single plant community and with limited topo-edaphic variability (e.g., a needle-and-thread/blue grama community at the base of a south aspect slope, on sandy loam soils) would not adequately represent the range of variability of an upland grassland physiognomic type. Even the sampling of 3 or 4 other similar site- and community-specific areas may not adequately represent the population of interest, which is the physiognomic type as a whole. Spatial auto-correlation of samples and the introduction of bias resulting from the proximity of previous sampling locations are additional concerns/complications when small reference sites are used. Conversely, random samples drawn from an extended reference area that includes the major upland grass communities on a representative range of topo-edaphic sites would fairly represent the undisturbed condition of the population of interest.

Extended reference areas are far more resilient to disturbance than community-specific reference sites. Small shrubland reference areas have been hit by lightning and burned, have experienced significant shrub die-offs, and have had to be relocated because of mine plan changes. One such site was narrowly missed by third-party road construction outside of a permit area. Expenses associated with obtaining approval for new reference areas can be reduced or eliminated through the use of extended reference areas.

With regards to environmental comparability, edaphic factors are often critical. However, soil characteristics are determined not only by the texture, composition and depth of the topsoil, but also by biological and chemical

activity that occurs *in situ* and greatly influences the type and amount of vegetation that will grow on a given site. Even though topsoil is salvaged and replaced, the structure, chemistry and biota of the replaced soil will not equate to an undisturbed area. Mixing of different soil types and textures, which occurs to a greater or lesser degree in any operation, further exaggerates the environmental differences between reclaimed and undisturbed substrates and tends to undermine the assumption of environmental comparability.

In this regard, reclaimed mine lands and adjacent unmined lands are similar to glaciated areas: One site starts over with a similar but highly altered substrate which is now devoid of biological activity. The adjacent reference area continues in an uninterrupted trajectory with its vegetation and soil biota intact.

All of these issues have a certain degree of validity in a wide range of environments. In environments with moderate precipitation, constant moderate to high humidity, and long growing seasons that coincide with favorable moisture regimes, high biological activity will tend to dampen the effects of past disturbance and environmental variation. None of these conditions prevails in eastern Montana, and, as a consequence, different conditions (historical or environmental) may result in very divergent, yet stable, plant communities.

### *1.2.3 Information Support for Technical Standards*

Technical standards must be based on reasonable understandings and expectations of plant communities in the area. The reclaimed areas should retain the general characteristics of the area (this is the ultimate goal of reclamation), even if they do not match any specific location in the unmined landscape. Therefore, vegetation performance standards should ideally be based on generalized characteristics and descriptions that have been derived from the landscape of concern.

These characteristics and descriptions for southeastern Montana are available through existing sources. A primary source for native rangeland can be found in the Ecological Site Descriptions developed by USDA Natural

Resources Conservation Service (NRCS). Most of the current coal mines fall within Major Land Resource Areas 58A (Northern Rolling Plains, Northern Part) and 58B (Northern Rolling Plains, Southern Part). A map showing the Major Land Resource Areas within Montana is available at http://www.mt.nrcs.usda.gov/technical/ecs/range/ecolsites. The individual Ecological Site Descriptions are available through the Electronic Field Office Technical Guides (EFOTG) at http://www.nrcs.usda.gov/technical/efotg; 58A files are accessed through Montana counties, while 58B files are accessed through Wyoming counties.

These site descriptions cover a broad range of information, some descriptive and some quantitative. Physiographic features, climate and soils data are provided with lists of representative soils for each county. Data are provided for plant community and species composition, relative dominance, and production for native grasses, shrubs and forbs. Cover is provided for plant growth forms and soil surface. Also provided is a discussion of the ecological dynamics, including descriptions of seral stages, historic climax plant community, and state and transition models between stages.

Information for improved pastures is also available through the NRCS EFOTG in the form of Forage Suitability Guides. These guides provide data on forage species suitability and expected production levels for native and introduced grasses and forbs for specific soil, climate, and site combinations.

Characterization of forests may be needed to derive technical standards for forestry post-mining land uses. In this case, forest productivity and stockability data are available from a number of sources (Jain et al. 2007, Pfister et al. 1977). The Custer National Forest also has extensive data on forest stand structure for the area (DiBenedetto 2007).

All of the above referenced existing sources of data can provide the basis for developing reasonable and appropriate vegetation technical standards for coal mine reclamation.

# APPLICABLE ACT, RULES, AND DEFINITIONS

Listed below are sections from Montana Code Annotated, Title 82, Chapter 4, Part 2 2005 ("the Act") and the Administrative Rules of Montana 17.24 ("the Rules") that are specifically applicable to vegetation reclamation standards. In cases where the Rules merely repeat or refer to the exact wording of the Act, only the sections from the Act are given.

An exact transcription of the Act and Rules is given, except where excessive wordiness diminishes clarity. In such cases, words are eliminated or paraphrased. Comments are given in italics.

## 2.1 INTENT

**82-4-202(1)** It is the legislature's intent that the requirements of this part provide adequate remedies for the protection of the environmental life support system from degradation and provide adequate remedies to prevent unreasonable depletion and degradation of natural resources.

**(2)(e)** The policy of the state is to demand effective reclamation of all lands disturbed by the taking of natural resources.

**(3)(c)** Coal mining alters the character of soils and overburden materials and duplication of pre-mining topography, soils, and vegetation composition is not practicable.

**(3)(d)** Standards for reclamation must be well-defined and consistent so that mine operators can reclaim lands disturbed by mining with confidence that the release of performance bonds can be achieved.

## 2.2 POST-MINING LAND USE

**82-4-203(28)** "Land use" means specific uses or management-related activities, rather than the vegetative cover of the land. Land uses may be identified in combination when joint or seasonal uses occur… categories include cropland, developed water resources, fish and wildlife habitat, forestry, grazing land, industrial or commercial, pastureland, land occasionally cut for hay, recreation, or residential. *Comment: Apparently these are the only categories of post-mining land use allowed by the Act.*

- Cropland: used for the production of crops for harvest, alone or in rotation with grasses and legumes;
- Developed water resources: used for storing water for beneficial uses;
- Fish and wildlife habitat: dedicated wholly or partially to the production, protection, or management of species of fish or wildlife;
- Forestry: used or managed for the long-term production of wood or wood-derived products;
- Grazing land: grasslands and forest lands where the *indigenous vegetation* is actively managed for livestock grazing or browsing or occasional hay production [emphasis added];
- Industrial or commercial: used for manufacturing facilities, warehousing and distribution, or retail trade;
- Pastureland: used for the long-term production of *domesticated forage plants* to be grazed by livestock or occasional hay production [emphasis added];
- Recreation: used for public or private leisure-time activities, including developed recreational facilities and undeveloped recreational uses;
- Residential: used for single or multiple-family housing, mobile home parks or other lodging.

**(42)** "Reclamation" means… to make those lands capable of supporting the uses that those lands were capable of supporting prior to any mining or to higher or better uses.

**(47)** "Restore" or "restoration" means reestablishment after mining and reclamation of the land use that existed prior to mining or to higher or better uses. *Comment: According to the Act, there seems to be no difference in meaning between "reclamation" and "restoration." Both are focused on the land use, but <u>not</u> on the vegetation per se.*

**82-4-232(7)** All disturbed areas must be reclaimed in a timely manner to conditions that are capable of supporting the land uses that they were capable of supporting prior to any mining or to higher or better uses as approved pursuant to subsection (8).

**82-4-233(1)** Vegetative cover on reclaimed areas must be:

**(a)** diverse, effective and permanent;

**(b)** composed of native species or desirable introduced species;

**(c)** at least equal in extent of cover to the natural vegetation of the area *[Note: not the pre-mining vegetation in that particular location, but rather, the natural vegetation in the general vicinity];*

**(d)** capable of stabilizing the soil appropriate to the approved post-mining land use. [*Note: OSM commented in their Final Rule for the Montana Regulatory Program (Federal Register, Feb. 16, 2005) that 82-4-233(1)(d) is interpreted to mean that "erosion control achieved by revegetation that meets the success standards will be equivalent to the erosion protection of unmined lands being used for the same purposes, within that general vicinity.]*

**(2)** Reestablished species must be compatible with approved post-mining land use; have the same seasonal growth characteristics as the original vegetation [*assume = pre-mining*]; and be capable of self regeneration and plant succession. *Comment: Species do not undergo succession; plant communities do.*

## DEFINITIONS:

*Some of the definitions pertaining to this section are found in 82-4-203 and ARM 17.24.301, but others are not provided in the Montana Act or Rules. Where these are lacking, the federal definitions will be followed.*

- Diverse: sufficiently varied amounts and types of vegetation to achieve ground cover and support the post-mining land uses… diversity does not necessarily mean that every species of grass, shrub, or trees be reestablished in identical numbers and ratios after mining.
- Permanent: the plant community *as a whole* must be capable of providing the necessary amount of ground cover over time through natural succession – not that every plant species will propagate itself in identical numbers and ratios. [Emphasis added]
- Cover at least equal in extent to the cover of the natural vegetation in the area: the area of ground covered by the combined aerial parts of the vegetation and the litter that is produced naturally on site, expressed as a percentage of the total area of measurement. [30 CFR 701.5] By comparison, ARM 17,24.301(28) defines cover as "the area of the ground covered by the aerial (above ground) plant parts."

These definitions are compatible. Therefore, **total cover for all land use types will be measured as the percent of the ground surface that is covered by the vertical projection of live vegetation and/or standing dead plant matter from perennial species.**

- Productivity: the vegetative yield produced by a unit area for a unit of time. [ARM 17.24.301(93)]
- Capable of stabilizing the soil surface from erosion: vegetative cover sufficient to stabilize the soil surface *with respect to reducing siltation to normal pre-mining background levels.* [Emphasis added]
- Same seasonal characteristics of growth as the original vegetation: the major season of growth for herbaceous species; in general this refers to cool season and warm season.
- Good ecological integrity: the complex of the community of organisms and its environment functioning as an ecological unit possesses components and processes in good working order. Pastureland and cropland managed in accordance with county or local conservation district or state or federal best management practices … generally reflect good ecological integrity with regard to such land uses. [ARM 17.24.301(46)]

## 2.3 WILDLIFE

**82-4-203(55)** "Wildlife habitat enhancement feature" means a component of the reclaimed landscape, established in conjunction with land uses other than fish and wildlife habitat, for the benefit of wildlife species (e.g., tree and shrub plantings, food plots, wetland areas, water sources, rock outcrops, microtopography, raptor perches, etc.).

**82-4-232(9)** The reclamation plan must incorporate appropriate wildlife enhancement features that are integrated with cropland, grazing land, and pastureland or other uses in order to enhance habitat diversity with emphasis on big game animals, game birds, and TES species… and to enhance wetlands and riparian areas along rivers and streams and bordering ponds and lakes. Incorporation of wildlife habitat enhancement features does not constitute a change in land use to fish and wildlife habitat and may

not interfere with the designated land use. *Comment: Elements of wildlife habitat diversity and special niches should thus be incorporated into crop, pasture or grazing land as "inclusions" in what would otherwise be classified as a different type of vegetation (e.g., sedges, rushes and cottonwoods around impoundments; woody shrubs in a small, incised channel within grassland; trees on a rocky point or island; rock outcrops or other landscape features).*

**17.24.751** Protection and Enhancement of Fish, Wildlife, and Related Environmental Values

**(2)(e)** Operators must consult with appropriate state and federal fish and wildlife and land management agencies to ensure that reclamation will provide for habitat needs of various wildlife species in accordance with the approved post-mining land use. They also must pay special attention to habitat features such as rock outcrops, boulders, snags, etc., and to plant species with nutritional and cover value for wildlife. Plant groupings and water sources must be distributed to fulfill the requirements of fish and wildlife.

**(2)(f)** Operators must restore or avoid disturbance to wetlands, riparian vegetation… and other habitats of unusually high value for fish and wildlife and, where practicable, enhance such habitats.

*These two sections put a clear emphasis on incorporating habitat features that are beneficial to wildlife within the landscape even when the designated post-mining land use may be pasture or cropland with no emphasis on wildlife utility. Thus the overall landscape should accommodate at least the incidental use by wildlife. This, however, does not require imposing a shrub and tree density standard outside of designated wildlife habitat emphasis areas. In fact, such a standard would do little to achieve the objectives of these sections.*

## 2.4 SUCCESS STANDARDS

**82-4-235(1)** Success of revegetation must be judged on the effectiveness of the vegetation for the approved post-mining land use, the extent of cover

compared to the cover occurring in the natural vegetation, and the requirements of 82-4-233. [see 2.2 Post-Mining Land Use above] Success standards are:

(a) Cropland – crop production must be at least equal to that achieved prior to mining based on comparison with historical data, comparable reference areas, or USDA publications applicable to the area of the operation.

(b) Pastureland or grazing land – the ground cover and production of living plants on the revegetated areas must be at least equal to that of a reference area or other standard approved by the department as appropriate for the post-mining land use.

(c) Fish and wildlife habitat, forestry, or recreation – determined on the basis of approved tree density standards or shrub density standards, or both, and vegetative ground cover required to achieve the post-mining land use. *Comment: No mention of comparison with a reference area is made here. No difference in meaning is implied between "ground cover" and "vegetative ground cover."*

(d) "Effective" means the post-mining land use is achieved and erosion is controlled.

(e) "Permanent" means the vegetation is diverse and effective at the end of the ten-year responsibility period. *Comment: Also see the federal definition for greater clarity.*

(f) If the reestablished vegetation is composed of native species or department approved introduced species then it is considered: to have the same seasonal characteristics of growth as the original vegetation, to be capable of regeneration and plant succession, and to be compatible with the plant and animal species of the area.

## 17.24.711 Establishment of Vegetation

(1)(a)(3)(b) For "pastureland" or "grazing land" designations, reestablished vegetation must have use for grazing by domestic livestock. *Comment: Utility for wildlife is not explicitly specified for pasture and grazing land vegetation, but see 82-4-232(9) in Wildlife above.*

(1)(a)(3)(c) For "fish and wildlife habitat, forestry, or recreation" reestablished vegetation must conform to "appropriate stocking rates" [meaning shrub

and/or tree density standards]. *Comment: Density standards and assessment of woody plants/acre is required for any land with a post-mining land use specified as wildlife habitat, forestry, or recreation, but not for pasture or grazing land.*

**(3)(a)** Cover, planting, and stocking specifications (for trees and/or shrubs) must be developed in consultation with and approved by FWP for reclamation to land uses for wildlife.

**(3)(b)** Cover, planting, and stocking specifications (for trees and/or shrubs) must be developed in consultation with and approved by DNRC for reclamation to land uses for forestry.

**17.24.724** Revegetation Success Criteria

**(1)** Success of revegetation must be determined by comparison with unmined reference areas or by comparison with technical standards. Reference areas and standards must be representative of vegetation and related site characteristics occurring on lands exhibiting good ecological integrity.

**(2)** Reference areas are parcels of land chosen for comparison to revegetated areas. A reference area is not required for vegetation parameters with approved technical standards. Reference areas must be in a condition that does not invalidate or preclude comparison to revegetated areas…

**(3)** Technical standards may be derived from: historical data, data from revegetated areas that are compared to historical data, or USDA, USDI, or other publications or sources relevant to the area and land use of interest and approved by the department.

## 2.5 Lands Disturbed Prior to 1978

The criteria for Phase III bond release for lands disturbed prior to the enactment of SMCRA (i.e. prior to May 2, 1978) are specified in **82-4-235(3), MCA** as follows:

**(a)** … on land from which coal was removed prior to May 3, 1978, and on land from which coal was not removed and that was not used, disturbed, or redisturbed after May 2, 1978, the department may approve for release a bond on an area of reclaimed vegetation that:

(i) was seeded using a seed mixture that was approved by the department under the criteria established pursuant to 82-4-233 and that included introduced species; and

(ii) at least one of the following conditions exists:

(A) the standards of 82-4-233(1) are otherwise achieved;

(B) the operator has demonstrated substantial usefulness of the reclaimed vegetation for grazing of livestock;

(C) the operator demonstrates that the reclaimed vegetation has substantial value as a habitat component for wildlife present in the area; or

(D) the topography and soils are suitable for conversion to cropland or hayland consistent with the standards of 82-4-232 and the department approves and the operator completes that conversion.

(b) On lands that meet the criteria described in subsection (3)(a), interseeding or supplemental planting may be performed without reinitiating the liability period provided in subsection (2).

# POST-MINING LAND USE: VEGETATION SUCCESS STANDARDS

Vegetation standards for reclamation must provide for stability and prevent excessive erosion irrespective of land use. Beyond this requirement, the criteria for success standards differ according to the approved post-mining land use, as is evidenced in the Act and Rules (see section 2.4), and will vary based on that use. For instance, annual production and vegetative cover would be expected to be higher in improved pasture with introduced species than in native grazing land; species and functional group diversity would be expected to be higher in grazing land than in pasture land. In addition, different measures of success apply to different uses (e.g. woody plant density). This section will reiterate the definitions provided for categories of post-mining land use and will detail those differences in standards and measurements.

## 3.1 CROPLAND

Cropland is used for harvested crops, whether annual crops such as small grains, or perennial, such as alfalfa hay, orchards or tree nurseries. As these lands may include plowing and fallow periods when no vegetative cover is present, a cover standard is not applicable. (Erosion control and stability must therefore be provided by characteristics such as limitations on slope, drainage design, shelterbelts, etc.)

Likewise, because the desired plant species are those planted for harvest, a vegetation community standard is also not applicable. The only plant species requirement is desirable agricultural species.

The primary performance standard for cropland is annual production of the desired crop, measured in the units that are typical for that crop (e.g. pounds/acre, bushels/acre, etc.) The numeric standards will be developed based on data from USDA Natural Resources Conservation Service, Farm Services Administration, the Montana Department of Agriculture and/or historic data from a reference location adjacent to the reclaimed area.

## 3.2 PASTURELAND

Pastureland is used for forage production that is typically removed by livestock grazing, but may also be occasionally hayed. Vegetation must be composed of primarily perennial herbaceous plants that may include or even be dominated by introduced species. The emphasis is on desirable forage plants, whether native or introduced. The relative dominance of the established species need not conform precisely to the relative proportions of the seed mix, and introduced grasses such as smooth brome, that were not deliberately seeded, may be present. The important criteria are that the established species are perennial and possess adequate forage value; vegetative composition will be assessed on that basis.

Vegetative cover and production are the primary performance standards for pastureland. The cover assessment will include total desirable perennial vegetation, including all native and desirable introduced herbaceous species, plus woody plants (if any). Production will be measured as total herbaceous perennial plant production (lbs/acre). The numeric standards will be developed based on data from USDA Natural Resources Conservation Service, specifically from the applicable Forage Suitability Groups of the Field Office Technical Guides and/or historic data in the vicinity of the reclaimed area.

Standards for ecological integrity (see next chapter) will be used to assess the vegetation as a whole for soil/site stability, hydrologic function, and biotic integrity. Standards for ecological integrity in pastureland will be based on ecological site descriptions for native rangeland, with appropriate modification based on information from the Forage Suitability Groups.

The primary use of pastureland is focused on forage for domestic livestock. However, pastureland is also specifically mentioned as one of those land uses where wildlife enhancement features should be incorporated. The presence and effectiveness of such features can be documented and assessed by looking at diversity across the landscape. In assessing the biotic integrity of pastureland, the arrangement and variety of wildlife habitat enhancement sites across the landscape will be considered.

## 3.3 GRAZING LAND

Grazing land is comprised of grasslands, shrublands and forested areas where the *indigenous* vegetation is actively managed for livestock grazing or browsing or occasional hay production. The emphasis is on native plant species which are useful for grazing or browsing. Introduced species, if present, should be a minor component of the plant community, comprising not more than 15% of the vegetation (based on percent composition). Generally speaking, they should not be included in the reclamation seed mix, though direct-hauling of topsoil will often result in an abundance of annual or perennial introduced species, if they were prevalent in the pre-mining vegetation. Fields in which introduced perennial grasses exceed 15% of the relative composition of the vegetation should be designated as pastureland and subjected to pastureland production and cover standards.

Because of the focus on native species and communities, vegetative diversity is an important characteristic for this land use type. The plant community must include a representative assemblage of species and life forms that would be expected in undisturbed areas, though given the mid-seral nature of reclaimed land by Phase III bond release, one would not expect the same proportions or relative dominance as would be found in undisturbed, late-seral (or even post-climax) plant communities. Every species of pre-mining grass, shrub, or tree need not be reestablished throughout the reclaimed area, but a preponderance of the species from the natural vegetation should be present, so the community has the same general character as the pre-mining vegetation. Such diversity within a given ecological site is important to ensure a fully functioning plant community, including its functionality for wildlife use.

By law, quantitative standards for cover and production must be applied to grazing land. Cover standards will be based on perennial vegetation at a similar stage of development. The cover assessment will include total desirable perennial vegetation, including all native and desirable introduced herbaceous species, plus woody plants. Noxious weeds and annual species will not count toward meeting the cover requirements.

Production standards and assessment will be based on total perennial herbaceous production. Production must focus primarily on herbaceous species, as trees and shrubs cannot be expected to have reached full production levels in as little as ten years. In addition, clipping to measure annual woody plant production is detrimental to the plants and counterproductive to achieving the desired results. The important criteria for woody plants is that they are present in the community and adequately vigorous to maintain that presence, mature, and contribute to further succession and development of the vegetation.

Standards for ecological integrity (see next chapter) will be used to assess the vegetation as a whole for soil/site stability, hydrologic function, and biotic integrity. These three attributes together address the requirement that reclaimed vegetation be "diverse, effective, and permanent" and have "good ecological integrity."

The primary use of grazing land is focused on forage for domestic livestock. However, as is the case in unmined, private ranch lands and livestock grazing allotments on public lands, these areas, to a greater or lesser extent, provide an important component of wildlife habitat. Grazing land is specifically mentioned as one of those land uses where wildlife enhancement features should be incorporated. The presence and effectiveness of such features can be documented and assessed by looking at diversity across the landscape. In assessing the biotic integrity of grazing land, vegetative diversity within a given ecological site, as well as the variety of sites and wildlife habitat enhancement features across the landscape, will be considered.

## 3.4 FISH AND WILDLIFE HABITAT

Fish and wildlife habitat is defined as land that is dedicated wholly or partially to the production, protection, or management of species of fish or wildlife. A gray area exists, in that croplands, pasturelands, and grazing lands are required to incorporate wildlife habitat enhancement features, and the requirement for native vegetation for grazing land implies a level of wildlife utility. Thus, all of these lands are expected to at least partially support use by wildlife.

However, in order to apply the appropriate vegetation standards, the designation of land use as fish and wildlife habitat must be clear, and should be a primary purpose of the post-mining land use, even if such use is limited to or concentrated in certain seasons. Examples include land that has been recognized as critical mule deer winter range or sage grouse breeding and rearing habitat prior to mining, and that has the requirement to replace pre-mining utility.

Shrub and/or tree density is the primary quantitative vegetation standard required by law for fish and wildlife habitat. Such a standard must take into account the early stage of development of the woody vegetation and must insure that the vegetation is on a trajectory toward the desired state. Thus, woody plant vigor, as well as density, needs to be considered. The standard must be developed in consultation with and approved by Montana Fish Wildlife and Parks.

The statutory requirement for the vegetation cover standard is that which is adequate to provide stability and prevent undue erosion, while supporting the approved post-mining land use. Specific numeric standards for cover will be set according to the vegetation desired to provide habitat for the targeted wildlife species.

Standards for ecological integrity will also apply to fish and wildlife habitat. However, the end state for the desired vegetation will often differ from that applied to grazing land. As such, different successional states will be used for assessing ecological integrity for fish and wildlife habitat than those applied to grazing land, and different states may be specified depending on whether utility for a particular wildlife species is desired.

## 3.5 FORESTRY

Forestry is defined as land used or managed for the long-term production of wood or wood-derived products. Given the environmental limitations for tree growth in the eastern Montana coal fields, land is not generally dedicated solely to forestry in the pre-mining state. However, much

of the private and public land is managed for forestry under a multiple-use scenario.

Tree density is the primary quantitative vegetation standard required by law for lands classified as primarily forestry for post-mining land use. The vast majority of forested lands in eastern Montana currently have an altered structure resulting from decades of fire exclusion and selective logging; this current forest structure is not sustainable. Therefore, a vegetative standard for tree density in lands designated for forestry will be based on a sustainable tree density and vegetation structure that contributes to long-term forest health. The end goal will be based on approximations of presettlement vegetation patterns.

The statutory requirement for the vegetation cover standard is that which is adequate to provide stability and prevent undue erosion, while supporting the approved post-mining land use. Thus the requirement for stability must be balanced with the need to limit moisture competition enough to ensure that the desired forest structure will develop over time (without replanting).

Standards for ecological integrity will also apply to forestry. The desired end state for forestry land is the potential natural vegetation under a pre-Euro American disturbance regime. Vegetation diversity and structure will be measured against an appropriate mid-seral stage that would be expected to eventually succeed to the historical climax plant community.

## 3.6 RECREATION OR RESIDENTIAL

Recreation land is that used for public or private leisure-time activities, including developed recreational facilities, such as campgrounds. Residential land is used for single or multiple-family housing, mobile home parks or other lodging.

None of these post-mining land uses have direction for vegetation success specified in the law or the rules with the exception that vegetation must be adequate to prevent excessive soil erosion and achieve the post-mining land use. Given the nature of recreation land as typically dominated by native vegetation, standards for ecological integrity will be applied as

appropriate. Likewise with residential land, standards for ecological integrity will be applied insofar as native vegetation is the desired matrix around anticipated housing development. Any desired forests must be of a structure and density that sustains forest health and does not pose an undue risk to life-safety or home ignitions during a wildland-urban interface fire.

Approval for these post-mining land uses can only be made upon submission of an alternative post-mining land use plan. Specific vegetation standards to ensure land stability, drainage and aesthetics will be developed in the course of that approval process, based on the specific design for the alternative post-mining land use. The standard for cover is that the vegetation must be adequate to provide stability and prevent excessive erosion.

## 3.7 INDUSTRIAL OR COMMERCIAL

Industrial or commercial lands are those used for manufacturing facilities, warehousing and distribution, or retail trade. The expectation for these lands is full development, and no vegetation standards for production or diversity apply. However, the vegetation cover combined with hardscaping must be adequate to provide stability and prevent excessive erosion.

## 3.8 LANDS DISTURBED PRIOR TO 1978

For regulated lands that were disturbed prior to the implementation of SMCRA, Phase III bond release may be met by any of the following:

1. meeting the Phase III standards as they apply to other post-SMCRA reclamation,

2. showing utility for livestock and/or wildlife, or

3. converting the area to cropland or hayland.

In most cases the simplest solution will be to demonstrate utility for livestock and/or wildlife. Such utility may be demonstrated by:

a) Submitting livestock use records and/or plant production records from at least two years that show production levels (AUMs and/or lbs. per acre)

that are at least 90% of the production levels shown in the appropriate NRCS Forage Suitability Guide or are at least 90% of production on comparable reference areas.

b) Demonstrating substantial value for wildlife habitat by using a study plan approved by the Department that makes comparisons between the pre-mining and post-mining wildlife communities.

Any one or a combination of these two methods may be used to demonstrate utility, thus meeting the standard to achieve Phase III bond release in regulated pre-1978 disturbance areas.

# STANDARDS FOR ECOLOGICAL INTEGRITY

The general goal for reclaimed mine lands in eastern Montana is to establish healthy rangeland vegetation that has good ecological integrity. The National Range and Pasture Handbook (USDA 1997) defines rangeland health as "*the degree to which the integrity of the soil, vegetation, water, and air, as well as the ecological processes of the rangeland ecosystem are balanced and sustained.*" It defines integrity as *"the maintenance of the functional attributes characteristic of a locale, including normal variability."* More specifically the goal is to reestablish native vegetation that is diverse, effective and permanent. On cropland and pastureland desirable introduced species are allowed.

The Act and Rules specify only production, cover, and density as quantitative vegetation standards that must be met. However, such single attribute assessments are inadequate to determine rangeland health because they do not reflect the complexity of the ecological processes (Pellant et al. 2005) and, therefore, do not serve as adequate assessments of rangeland health.

A method for assessing rangeland health has been developed over the last decade by an interagency team of range ecologists from the Agricultural Research Service, the Bureau of Land Management, the Natural Resources Conservation Service, and the U.S. Geological Survey. This method will form the basis for assessing the required qualitative standards for revegetation success (diverse, effective, and permanent) for the Montana Department of Environmental Quality. An explanation of the theory and basic approach of the methodology follows.

## 4.1 INTERPRETING INDICATORS OF RANGELAND HEALTH

*Interpreting Indicators of Rangeland Health, Version 4* (Pellant et al. 2005) is published as Technical Reference 1734-6 by the National Science and Technology Center of the Bureau of Land Management.[1] The methodology is a

[1]The document is available online at www.blm.gov/nstc/library/techref.htm. A copy may be ordered from:
BLM National Business Center
Printed Materials Distribution Service, BC-652
P.O. Box 25047 By FAX: 303.236.0845

qualitative assessment of three major attributes: soil/site stability, hydrologic function, and biotic integrity. Seventeen indicators make up the assessment of the major attributes. Of these indicators, ten apply to soil/site stability, ten apply to hydrologic function, and nine apply to biotic integrity. Thus many of the indicators are used in assessing two or more of the major attributes.

The methodology has been adopted as the standard for determining rangeland health by most of the federal agencies concerned with rangeland management: the Natural Resources Conservation Service, the Bureau of Land Management, and the Bureau of Indian Affairs. It is also used to a lesser degree by the U.S. Fish and Wildlife Service and the National Park Service.

Though the overall assessment is qualitative in nature, information can be supplemented with quantitative data for many of the indicators. A few indicators have no quantitative equivalent because some ecosystem properties are more accurately reflected by qualitative indicators (Rapport 1995). As Albert Einstein observed, "Some of the things that you can count don't really count; some of the things that you can't count really do count." Where it is desirable to augment the qualitative data with quantitative measures, one should select the best quantitative indicators for each of the three *attributes*, rather than selecting an equivalent quantitative measure for each qualitative indicator (Pellant et al. 2005).

*Interpreting Indicators of Rangeland Health* is predicated on a classification system that identifies distinct sites based on the type and amounts of vegetation that can potentially grow there. The existing Ecological Site Descriptions for eastern Montana provide such a classification system. These descriptions also provide the basis for developing Reference Sheets that describe the indicator characteristics of healthy vegetation for that site. Evaluations of the indicators are then based on the observed departure from the expected characteristics provided in the Reference Sheet for each ecological site.

Reference Sheets have already been developed for some Ecological Site Descriptions and are lacking for others. However, even where Reference Sheets

already exist, they may need to be modified for assessing reclaimed vegetation. Two reasons exist for this:

1. Many of the Reference Sheets already developed for the Ecological Site Descriptions are descriptive of the historic climax plant community and, as discussed earlier, one would not necessarily expect full development of the vegetation in as little as ten years. A different community within the threshold that includes the historic climax plant community may be more appropriate.

2. In some cases, such as pastureland or fish and wildlife habitat, the desired plant community does not coincide with the historic climax plant community. In the first case, introduced species may be a prevalent component of the community, and thus the expected plant functional/structural groups and annual production would likely be modified, though most other indicators would apply directly. In the second case, greater dominance by shrubs might be important, which is typically associated with reduced grasses and increased bare ground. In order to assure that the post-mining land use goals are met, the Reference Sheet should be tailored to those goals.

The Ecological Site Descriptions include extensive plant species lists (all of which are not expected to occur at any one locale), ranges for annual production, and detailed discussions of ecological dynamics, along with state and transition models. This information, along with data from the mine sites and local expert knowledge, should allow for adequate development of applicable Reference Sheets.

In summary, indicator characteristics described in the NRCS Ecological Site Descriptions will provide the basis for qualitative standards for ecological integrity for pastureland, grazing land, fish and wildlife habitat, forestry, recreation, and residential post-mining land uses. For many of these uses, Reference Sheets will need to be modified or developed from scratch. Information from the NRCS Forage Suitability Groups will be combined with the Ecological Site Descriptions for use in assessing improved pastureland. The qualitative standards do not apply to cropland.

## 4.2 OUTLINE OF THE METHODOLOGY

The basic steps in the Rangeland Health Assessment protocol are described below. This description is not intended to be complete and instructional, but rather an outline to familiarize the reader with the basic elements of the approach. **Important concepts and details of the methodology must be obtained through a thorough study of Technical Reference 1734-6.**

### *4.2.1 Steps in the Process*

Technical Reference 1734-6 postulates five steps in the Rangeland Health Assessment protocol.

**Step 1** is to identify the evaluation area and to **determine the soil and ecological site.** In the case of a bond release application, the evaluation area will be the acreage described in the application. Ideally, the soil and ecological site determinations will be completed before the application for bond release has been submitted. Identification of site characteristics early in the reclamation process will allow operators to fine tune management practices over the period of responsibility, so as to increase the operators' ability to achieve the desired vegetation. If the vegetation is on a different track than expected, such lead time will allow for ground-truthing and correction of misidentified sites or management adjustments to achieve the desired state before application for Phase III bond release.

**Step 2** is to obtain or **develop the Reference Sheet** that will be used in the assessment. For the most part, these Reference Sheets will be developed by MDEQ personnel, with advice and assistance from NRCS, BLM, USFS, FWP and other local experts. The existing Reference Sheets from the Ecological Site Descriptions will be used as a starting point. Alternatively, Reference Sheets may be developed based on examination of the approved reference areas existing on a given mine. Vegetation monitoring data and local weather data from the mines will serve as additional input. Mine personnel and vegetation consultants who have years of familiarity with pre- and post-mining soils and vegetation will

also have an important role to play in the development of Reference Sheets, insuring that realistic expectations are established.

A corollary step to developing the Reference Sheet is to **develop the Evaluation Matrix** that will accompany the Reference Sheet. The Evaluation Matrix provides descriptions for each indicator for the five states of departure from what is expected for the site: None to slight, Slight to Moderate, Moderate, Moderate to Extreme, and Extreme to Total. The development of the Evaluation Matrix will follow that of the Reference Sheet, described above.

**Step 3** is to **collect supplementary information**. This step is designated as optional in the technical reference. However, at a minimum, operators will need to collect the quantitative information that is required for bond release (cover, production, and/or density). Additional quantitative information to directly support the rangeland health assessment is suggested in Table 2 and in Appendix 6 of Technical Reference 1734-6. Operators should consult with MDEQ to insure applicability of additional quantitative or other supplementary data that they propose to collect in support of Phase III bond release.

**Step 4** is to **rate the 17 indicators** on the Evaluation sheet and to justify those ratings with written comments. These field ratings are to be conducted only by trained professionals with a good understanding of the ecological processes, vegetation, and soils of the area being evaluated (Pellant et al. 2005). Ratings of bond release areas will be completed by MDEQ personnel, with a minimum of two people representing at least two disciplines (vegetation plus soils and/or hydrology). Ideally, they will be completed with all three disciplines represented.

**Step 5** is to **determine the functional status of the three rangeland health attributes** based on the ratings of the 17 indicators. The ratings of the three attributes (soil/site stability, hydrology, and biotic integrity) must be justified with written comments. The appropriate departure category for each attribute is based on a preponderance of evidence from the

indicator ratings that make up that attribute (see below). **In order to achieve the standard for ecological integrity for the purposes of Phase III bond release, a departure from expected of no more than "slight to moderate" must be achieved for each of the three attributes.**

### *4.2.2 Descriptions of the 17 Indicators*

The following table lists the 17 indicators used in the attribute evaluation process and denotes the attributes to which each applies.

Table 1. Relationship of range health indicators to the three functional attributes.

| | Functional Attributes | | |
|---|---|---|---|
| **Indicator** | **Soil/Site Stability** | **Hydrology** | **Biotic Integrity** |
| 1. Rills | X | X | |
| 2. Water-flow patterns | X | X | |
| 3. Pedestals and/or terracettes | X | X | |
| 4. Bare ground (%) | X | X | |
| 5. Gullies | X | X | |
| 6. Wind-scoured, blowouts or deposition areas | X | | |
| 7. Litter movement | X | | |
| 8. Soil surface resistance to erosion | X | X | X |
| 9. Soil surface loss or degradation | X | X | X |
| 10. Plant community composition and distribution relative to infiltration | | X | |
| 11. Compaction layer | X | X | X |
| 12. Functional/structural groups | | | X |
| 13. Plant mortality/decadence | | | X |
| 14. Litter amount | | X | X |
| 15. Annual production | | | X |
| 16. Invasive plants | | | X |
| 17. Reproductive capability of perennial plants | | | X |

Each of these indicators is given a rating for the departure from expected from "none to slight" to "extreme to total." If a particular indicator is not present (e.g. no gullies exist) it is rated as "none to slight." The ratings for each indicator are then tallied under the attributes to which they apply, and attribute ratings are determined. **The attribute ratings are not simply a numerical average of their respective indicator ratings. Interpretation of the relative importance of each indicator is required.**

The meaning for many of the indicators is apparent. Some of the more obscure indicators are described below. Definitions and/or explanations for the indicators come from Pellant et al. 2005.

- **Pedestals and/or terracettes**: Pedestals refers to rocks or plants that appear elevated as a result of soil loss by wind or water erosion. Similar effects can also be caused by non-erosional processes such as frost heaving, thus evaluators must be able to distinguish such processes from erosional ones. Terracettes are benches of soil deposition caused by water movement (not wind). Terracettes caused by livestock and wildlife movements on hillsides are not considered erosional terracettes, though they may affect erosion or alter infiltration.

- **Bare ground** refers to exposed mineral or organic soil. Anything covered by rock, litter, standing dead vegetation, biological crust or plant basal and/or canopy cover is not considered bare ground.

- **Litter movement** refers to whether the redistribution of litter occurs within a small area or is transferred offsite. The size of litter moved by wind or water is also an indicator of the degree of litter redistribution. The greater the distance and the larger the size of litter moved, the more the site is subject to erosion.

- **Soil surface resistance to erosion** depends on soil stability and its spatial variability relative to vegetation and microtopographic features. Biological crusts, decomposing organic matter, and soil organic matter aggregates all contribute to stabilizing the soil surface.

- **Soil surface loss or degradation** refers not only to loss through erosion, but also to degradation of the surface horizon. Loss of soil structure (i.e. aggregates) and/or surface organic matter reflect a degraded soil surface.

- **Plant community composition and distribution relative to infiltration and runoff** is an assessment of how plant rooting patterns, litter production, basal area, foliar cover and plant spatial distribution affect infiltration and/or runoff. An example of a composition change that reduces infiltration is the conversion of desert grasslands to shrub-dominated communities.

- **Compaction layer** refers to a soil structural change, as opposed to a textural change.

- **Functional/Structural groups** are species that are grouped together because they share a characteristic influence on the community. They are species with similar shoot and root structures, photosynthetic pathways, nitrogen fixing ability, and/or life cycle. Examples include warm season tall perennial grasses, leguminous shrubs, or perennial forbs. Functional composition and functional diversity are principal factors in plant productivity, plant percent nitrogen, plant total nitrogen and light penetration (Tilman et al. 1997). These characteristics in turn have effects on the utility of a community and the habitat niches available for animals, birds and insects. A diverse assemblage of functional and structural groups thus supports wildlife diversity.

- **Litter amount** refers to dead plant material that is detached from the base of the plant and lying on the soil surface. Standing dead plant material is not considered litter.

- **Invasive plants** include native and introduced plants that have the potential to become dominant or co-dominant species on the site if their future establishment and growth is not actively controlled by management interventions. This indicator, by definition, includes

noxious weeds. Species that become dominant for only one to several years are not invasive plants.

The information presented here is a brief and excerpted summary of *Interpreting Indicators of Rangeland Health*. Extensive information regarding the assessment protocol, the 17 indicators, the three functional attributes, and the ecological theory and supporting evidence behind this methodology is provided in Technical Reference 1734-6. Operators who expect to use the methodology in applying for Phase III bond release should be thoroughly familiar with that document.

## 4.3 Implementation for Phase III Bond Release

The Rangeland Health Assessment protocol will be applied during Phase III bond release field inspections. The assessments must be carried out by at least two inspectors, including one vegetation specialist and either a surface water hydrologist or a soil scientist, or both. As is the case for all bond release inspections, mine personnel and members of the public may attend. Ratings will be made only by inspectors who have been trained in the use of the protocol.

The threshold for acceptability will be that no one of the three attributes of rangeland health is rated with more than a slight to moderate departure from the associated Reference Sheet (i.e., "slight to moderate," and "slight to none" are acceptable). Individual indicators may receive less favorable ratings; however, such ratings would be expected to be few and relatively insignificant for the site as a whole. The preponderance of evidence must indicate no more than slight to moderate departure from the Reference Sheet for soil/site stability, hydrologic function, and biotic integrity. See the discussion under "Step 5" in "Instructions for Using the Rangeland Health Assessment Protocol" in Technical Reference 1734-6.

Mine operators are encouraged to complete training in the use of the protocol and to use it to assess reclaimed vegetation prior to application for Phase III bond release. They are also encouraged to submit any supplementary data that have been collected in support of the bond release application. See

the discussion under "Step 3" and Appendix 6 in Technical Reference 1734-6. Any data that are submitted will be considered in the ratings. However, data collected in years prior to the application and inspection may or may not agree with current conditions on the ground, and thus may or may not reasonably be used to supplement the ratings at the time of the bond release inspection.

Because the Rangeland Health Assessment protocol is qualitative in nature, some fear that it is completely subjective and therefore unpredictable and susceptible to personal bias. If the mine operator, land owner, or a member of the public who was in attendance at the bond release field inspection disputes the conclusions of the assessment, an independent assessment using the same protocol may be conducted by NRCS personnel who have been trained in the methodology and are familiar with local plant communities. If Montana DEQ believes that an independent assessment is warranted and if NRCS personnel are not available, the independent assessment may be conducted by a Certified Professional in Rangeland Management (as designated by the Society for Rangeland Management). Although the final determination for bond release rests with Montana DEQ, the independent assessment will be considered in the final determination.

## 4.4 Wildlife Habitat Enhancements

MSUMRA requires that wildlife habitat enhancement features be incorporated into cropland, pastureland and grazing land. Generally speaking, such areas will incorporate different plant communities and/or different ecological sites. Examples of the former include dense shrub or tree plantings; examples of the latter include wetlands (permanent impoundments), woody draws, or rock outcrops. A minimum of 5 percent of these land use areas should consist of wildlife habitat enhancement features.

# STANDARDS FOR PRODUCTION, COVER, AND DENSITY

Quantitative measurements are required by law for production in cropland, production and cover in pastureland and grazing land, for cover in all other land uses, and for woody plant density in wildlife habitat and forestry. Discussion of the derivation of the standards for each of these land uses is provided below. For all comparisons, the reclaimed vegetation must equal at least 90 percent of the comparison level, assessed at the 90 percent confidence interval.

## 5.1 CROPLAND

The ideal comparison for cropland production is an adjacent unmined area that is under the same management, if one is available and comparison measurements can easily be made. Reference areas work well for cropland because intense and repeated management keeps the reference area in a similar state as the reclaimed area, without successionally induced changes in soils and vegetation.

In the absence of such a reference area, local production data from NRCS or the Farm Services Administration will be used for the crop in question, whenever possible matching the data to that from a similar soil type. If the current year's data are not available, comparisons will be made with average annual production.

## 5.2 PASTURELAND

Production standards for pastureland will be derived from the NRCS Forage Suitability Groups, matched according to soils and climate. "Low" and "High" levels will be applied according to the favorability of the growing season. The Forage Suitability Groups provide data for native and introduced, as well as warm and cool season species. Production standards for pastureland may also be derived from historic data from the vicinity of the reclaimed area.

The Forage Suitability Groups do not provide data for cover. Therefore, cover standards for pastureland will be based on the total vegetative canopy

cover expected in the historic climax plant community for the climate and soil type as given in the applicable Ecological Site Description. The cover values from the historic climax plant community will be used as the technical standard because improved pastureland would be expected 1) to be strongly dominated by perennial grasses, and 2) to be at least as dense as native vegetation (at least in the first two decades after establishment). Cover standards for pastureland may also be derived from historic data from the vicinity of the reclaimed area.

Cover will be measured as the percent of the ground surface that is covered by the vertical projection of live vegetation and/or standing dead plant matter from perennial species. This measure must exceed or equal 90 percent of the cover standard at the 90-percent confidence interval. If the standard is derived from plant community descriptions that provide a range for total cover, reclaimed vegetation must have cover levels greater than or equal to the lower value in the range provided, or at least 90 percent of the mid-range, both at the 90% confidence interval.

## 5.3 GRAZING LAND

Production and cover standards for grazing land will be derived from the applicable NRCS Ecological Site Description matched according to mean annual precipitation. They may also be derived from historic data from the vicinity of the reclaimed area. Production will be measured as total herbaceous perennial production (less any noxious weeds) and must equal at least 90 percent of the average total annual production listed in table 7a of the appropriate Ecological Site Description (or the historically derived standard).

Cover will be measured as the percent of the ground surface that is covered by the vertical projection of live vegetation and/or standing dead plant matter from perennial species. This measure must exceed or equal 90 percent of the cover standard at the 90-percent confidence interval. If the standard is derived from plant community descriptions that provide a range for total cover, reclaimed vegetation must have cover levels greater than or equal to the lower value in the range provided, or at least 90 percent of the mid-range, both at the 90% confidence interval.

## 5.4 WILDLIFE HABITAT

Shrub and/or tree density requirements for designated wildlife habitat areas will be established on a site-specific basis in consultation with and approval from Montana Fish Wildlife and Parks personnel.

Cover must be adequate to achieve the post-mining land use and to provide soil stability and prevent undue erosion. Specific numeric standards will be set according to the vegetation required to provide habitat for the targeted wildlife species. For instance, cover requirements for a waterfowl nesting area will obviously be different from those for big-game winter range.

Again, the primary goal for the cover standard is soil stability and erosion control. Cover will be measured as the percent of the ground surface that is covered by the vertical projection of live vegetation and/or standing dead plant matter from perennial species. This measure must exceed or equal 90 percent of the cover standard at the 90-percent confidence interval. If the standard is derived from plant community descriptions that provide a range for total cover, reclaimed vegetation must have cover levels greater than or equal to the lower value in the range provided, or at least 90 percent of the mid-range, both at the 90% confidence interval.

## 5.5 FORESTRY

Tree density requirements for designated forestry areas will be established on a site-specific basis in consultation with and approval from Montana Department of Natural Resources and Conservation personnel. Additional information regarding appropriate stocking levels for forest species is available in *Forest Habitat Types of Montana* (Pfister et al. 1977) and for selected sites in the Ecological Site Descriptions.

Cover must be adequate to achieve the post-mining land use. Specific numeric standards will be set based on comparable forest habitat descriptions (Pfister et al. 1977, Jain et al. 2007).

Again, the primary goal for the cover standard is soil stability and erosion control. Cover will be measured as the percent of the ground surface that is

covered by the vertical projection of live vegetation, litter, and/or standing dead plant matter from perennial species. This measure must exceed or equal 90 percent of the cover standard at the 90-percent confidence interval. If the standard is derived from plant community descriptions that provide a range for total cover, reclaimed vegetation must have cover levels greater than or equal to the lower value in the range provided, or at least 90 percent of the mid-range, both at the 90% confidence interval.

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